

The Changed Brain: Teacher Awareness of Traumatic Brain Injury
And
Classroom Instruction Methods to Enhance Cognitive Processing in Mathematics

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Abstract

Traumatic brain injury has come to subjugate and exert its authority on education as some survivors re-enter the academic arena. A key component of a TBI student's academic success is dependent upon a teacher's awareness of the TBI learner and a willingness to modify curriculum to promote the uniqueness of the changed brain and therefore, increase the TBI student's probability of academic success in mathematics.

This researcher examined teacher awareness of the manifestation, causes, symptoms, and treatments of TBI as it relates to educating TBI students in a mathematics classroom setting. Additionally, this researcher attempted to extend research regarding the extent to which mathematics teachers are willing to improve their awareness and methods of teaching, and to attend professional development opportunities.

The results of this survey indicated that 68% of the teachers surveyed retain an adequate basic knowledge of TBI. The survey also indicated a willingness of mathematics teachers to pursue educational offerings to improve their awareness and to address the needs of TBI students in their classroom. Finally, the survey indicated a lack of support by school administration to support teachers' efforts through professional offerings or supplementary resources to aid them in their delivery of instruction.

Introduction

Medical advancements in the diagnosis and treatment of traumatic brain injury (TBI) have resulted in thousands of individuals surviving and living with the ramifications of a brain injury. TBI has come to subjugate and exert its authority on education as some survivors re-enter the academic environment.

A key component of an individual's academic success is dependent upon a teacher's awareness of TBI. Teachers must retain basic knowledge of TBI including its biological basis, causes, symptoms, and treatment. Teachers can then develop effective instructional plans to adequately address the educational concerns of this changed brain. Examples specific to the teaching of mathematical methods is delineated in this research study.

Appropriate training, in-service seminars, and a willingness to adapt each student's learning to their abilities, is necessary for students to increase their probability of achieving mathematical and general academic success after experiencing such an injury to the brain.

Problem Statement

If teachers lack awareness of the manifestation and the cognitive ramifications of TBI, then the TBI learner may not achieve their academic potential. This issue should be investigated due to the direct influence teachers have on educating and observing students in their classrooms and ensuring appropriate instruction is provided to aid academic success post injury.

Elements of the Problem

A problem exists in the educational community whereby teachers are not fully aware of TBI—its biological basis, causes, symptoms, and treatments. As a result, TBI students may not be receiving educational instruction geared to their academic needs to experience the least restrictive pathway to learning.

Symptoms of TBI can often be disguised as other disabilities such as Attention Deficit Disorder and thus, many students are receiving special education services for a condition that may not be accurately reflected in academic instruction.

Teachers must show awareness in selecting curriculum and delivering instruction to promote the uniqueness of the changed brain and therefore, increase the TBI learner's probability of academic success in mathematics and other subject areas.

Purpose of the Study

This study will explore teacher awareness of manifestation, causes, symptoms, and treatments of TBI as it relates to educating TBI students in a mathematics classroom setting.

Additionally, this study will serve to extend research regarding the extent to which special and general education teachers are willing to improve their awareness and methods of teaching, and to attend professional development opportunities such as in-services, workshops or TBI endorsement certification. Specific to mathematics instruction, this study will offer discuss alternative mathematical instruction practices to address the challenges of the TBI student.

Research Objective

The question driving this investigation is to determine the level of knowledge and awareness of special and general education teachers of the manifestation of traumatic brain injury students relative to its causes, symptoms, treatments, and instruction methods.

An objective of this research is to increase educator awareness to the manifestation of TBI and its implications in the educational setting with specific mention of mathematical cognition.

Definition of Terms

The following are terms which will serve to add meaning to this research study:

“Attention-Deficit Disorder (ADD) is a syndrome, usually diagnosed in childhood, characterized by a persistent pattern of impulsiveness, a short attention span, and often hyperactivity, and interfering especially with academic, occupational, and social performance.”
(Answers.com. Online at www.answers.com)

Cognition is “the mental process of knowing, including aspects such as awareness, perception, reasoning, and judgment.” (Answers.com. On line at www.answers.com)

Neurocognitive is a “term used to describe cognitive functions closely linked to the function of particular areas, neural pathways and workings in the brain.” (Answers.com. On line at www.answers.com).

Fragile X Syndrome is “an inherited disorder caused by a defective gene on the X-chromosome and causing mental retardation, enlarged testes, and facial abnormalities in males and mild or no effects in heterozygous females. It is the most common inherited cause of mental retardation.”
(Answers.com. On line at www.answers.com)

Intraparietal Sulcus is “a horizontal sulcus extending from the postcentral sulcus and dividing into two branches to form with the postcentral sulcus a figure H that divides the parietal lobe into a superior and an inferior lobule.” (Answers.com. On line at www.answers.com)

Magnetic Resonance Imaging (MRI) “scanners rely on the principles of atomic nuclear-spin resonance. Using strong magnetic fields and radio waves, MRI collects and correlates deflections caused by atoms into images.” (Answers.com. On Line at www.answers.com)

Traumatic Brain Injury “is sudden trauma causing damage to the brain.” (NINDS–2007)

Chapter II: Literature Review

Introduction

The brain has been fascinating researchers for centuries. The brain defines the individual into which we evolve. Attempting to ascertain how the brain learns has become of particular interest during the 21st century as access to medical technologies open new windows of understanding. Scientists can now begin to disengage the mysteries of the brain, how it functions, and more importantly, how it learns.

Valiant medical efforts are now saving the lives of children who, years ago, would not have been as fortunate. However, often times, these children are afflicted with traumatic brain injuries (TBI) and experience learning disabilities that affect their learning capacity. Scientists are now better equipped to gain insight into the changed brain, and to disseminate this knowledge to educators to help individuals face the challenges of any residual learning disabilities.

Research for this study was extensively found in articles and journals. Lack of studies performed beyond the 1990's was difficult to locate but is dispersed through the paper. Major sources include studies performed by educational professionals and neurocognitive scientists who seem to blend their ideas into a methodology to address the manifestation of TBI. The reader will find extensive literature due to a passionate thrust of interest by the researcher of this study.

Sharing this newly found knowledge with the educational community may increase the learning potential for TBI individuals returning to the classroom. Increased teacher awareness of the manifestation of traumatic brain injury - its causes, symptoms, and treatments may aid in the effective delivery of academic instruction.

Gardner (2001) believes that we are all defined by the uniqueness of our brains, so to is the distinctness of each brain injury. By focusing on the uniqueness of the TBI learner and their specific challenges, educators will better understand the symptoms of the disability and streamline instruction to enhance their academic success.

According to the National Institute of Neurological Disorders and Stroke (NINDS) (2007), a traumatic brain injury is defined as “a sudden trauma causing damage to the brain”. This definition includes both open and closed head injuries. According to this source, an open head injury is one where an object penetrates through the skull, whereas a closed head injury occurs when the head is violently shaken or hit by an object. NINDS defines the term TBI as excluding brain damage caused by genetics, unexplained natural brain deterioration, and injuries resulting during childbirth.

Chapman (2002) contends that the deviation in developmental outcomes is the differentiating factor separating TBI from other disabilities. Each traumatic brain injury is unique and presents unparalleled challenges dependent upon the damaged area of the brain and the type of movement on the skull which causes the injury. Chapman (2002) suggests that rapid recovery of brain functions within the first year is quite common; however, a leveling effect can show minimal progress over longer periods of time.

Educating the TBI population presents new challenges for school districts around the country. It seems logical to simply enhance the provision of individualized instruction to meet the special needs of the TBI learner. However, due to the encompassing problems exhibited by TBI students - intellectually, educationally and behaviorally - their path to educational success can be profoundly complicated.

Williams (1994) believes that cognitive deficits are disrupted in the TBI individual. This loss of balance results in impaired cognitive functioning within the brain. It is suggested that the brain must retrain itself to perform step-by-step functioning. He outlines three specific regions which are disrupted in TBI individual including executive functioning, attention, and memory. Executive functioning affects frontal lobe activity such as behavior and information recognition. Attention affects the difficulty to stay focused on specific tasks, and memory affects the ability to remember both short-term and long-term information.

How aware are teachers of the manifestation of TBI and how receptive is the educational community to offering alternative methods of instruction to utilize this new knowledge to enhance the academic success of TBI students?

Biology of the Brain

Each day in America, millions of teachers enter educational facilities prepared to disseminate vast amounts of knowledge to their students. Essentially, their job is to change the brains of their students.

Cooley and Glang (1994) contend that teachers have a lack of knowledge regarding TBI and an inability to completely understand the wide array of learning disabilities confronting students. They claim that teachers must understand the vastness of the brain's learning abilities and possess a rudimentary understanding of the biological workings of the brain in order to address the learning capabilities of those with TBI.

In simplistic terms, Sousa (2006) states that the brain is a gel-like mass that weighs approximately three pounds and can fit in the palm of your hand. It is an organ situated at the top of the spinal column and is nestled inside the skull and protected by membranes. The brain is continually processing information and never stops to rest!

Sousa (2006) explains how the exterior parts of the brain appear as wrinkles and folds. These folds make up four lobes. The frontal lobe is located behind the forehead and is responsible for planning, thinking, judgment, and creativity. The temporal lobe is located above the ears and is responsible for memory, meaning, language, and hearing. The occipital lobe is located at the back of the head and is mainly responsible for visual processing. Finally, the parietal lobe is located on the top back area and is responsible for calculation, spatial awareness, and sensory awareness.

Sousa (2006) describes the interior workings of the brain as being separated into three main functions. The brainstem is compared to a control center of a brain and the limbic system is the emotional and reasoning thermometer. The cerebrum permits speaking, thinking, remembering, and moving. The corpus callosum supplements the cerebrum. This thick cord is lined with millions of nerve fibers which form a bridge to allow the right and left brain hemispheres to communicate with each other.

Learning Theories Affecting Mathematics and TBI

Theories can be utilized to analyze practices from the past and provide insight for future with the goal of making sound decisions. Theories are especially important for the development of current practices in the classroom to aid identified TBI learners.

Behaviorists believe that all learned behaviors can be adjusted and replaced by new behaviors. Based on this theory, theorists would believe that the TBI student could retrain their brain through a series of positive and negative re-enforcers. For example, a teacher may first demonstrate a mathematical problem, and ask the student to work independently, and finally correct the problems and provide feedback, both positive and negative to the student.

Cognitive theory emphasizes learning as a thinking process. Piaget's work studied thought processes and the effect of the environment on cognitive functioning. He claimed that children progressed in sequential stages of cognitive development. In this way, the teacher's role is to provide an environment to ensure that taught skills can be learned and retained. Following this theory, the TBI student should be given opportunities to reconstruct their schema by linking prior experiences to new situations, and must be provided with strategies to learn new tasks, must be given practice on repetition to improve automatic recall and must be personally motivated.

Vygotsky emphasized the importance of cultural experiences and social interactions during the learning process in what was coined, Socio-Cultural Theory. Through the creation of the Zone of Proximal Development (ZPD), Vygotsky claimed that the student and teacher set goals together whereby the teacher determines the appropriate scaffolding required, and the place of independent learning. Vygotsky believed that retraining the brain could be accomplished through such techniques as modeling, peer mentors, internships or scaffolding.

Meta cognitive theory places emphasis on the thought processes of mathematical calculation. This theory deals with a student's own awareness of their thinking process and their personal commitment to regulating this awareness. This is seen in cognitive strategies such as goal setting, planning learning strategies like making study cards, and assessment and adjustments to this thinking plan. In the TBI student, these skills become abundantly important thought processes as the brain requires assistance to reorganize and prioritize learning processes.

Gardner addressed the uniqueness of learning. Gardner suggested that people could optimize their learning capabilities if the material was presented within one of eight individually preferred categories, one of which was logical-mathematical. This theory can be applied to the

instruction of students suffering from disabilities such as TBI. If a mathematics instructor was aware of a student's TBI condition, and also applied Gardner's Multiple Intelligence Theory, the TBI student's chances of retaining new skills may be increased.

Most recently, John Anderson as proposed a theory entitled Adaptive Character of Thought (ACT-R). Anderson's theory speaks directly to the subject of mathematics in that it attempts to reveal how people think and invade mathematical problems. ACT-R claims that thought processes are derived from procedural and declarative knowledge. Procedural knowledge is responsible for the encoding instructions, the "how to", while declarative knowledge addresses an encoding of actual facts. Anderson's theory answers the question of how well procedural and declarative knowledge interact to develop cognition. In its application, Anderson claims students should be given in their area of mathematical weakness, and not move on to more complex concepts until the concept is mastered.

The preceding presentation of theorist views concludes that there is no apparent agreement in defining an ultimate cognitive learning vehicle. However, with respect to teacher awareness of students with TBI, there appears to be some consensus to the benefits of teacher awareness in acknowledging the learning style and the potential advantages of individual teaching instruction as an important component in the brain's capacity to process information efficiently.

History of TBI

The first documented case of traumatic brain injury occurred in 1848 when a man named Phineus Gage, a 25 year old railroad worker, was injured when a 3 foot packing rod was propelled through his head. The rod entered through the skull, traveled through his brain, and exited the skull. Though tragic as it may be, this accident contributed to a new understanding about the manifestation of brain injuries and resonated throughout the medical community. Prior to this incident, Gage was an endearing, kind, gentleman. Post injury, Gage was difficult, unfriendly and arrogant. It was documented by his physician that Gage displayed this “brain change” until his death.

Lerner (1993) states that in 1947, Alfred Strauss and Laura Lehtinen classified a group of children who had exhibited maladaptive behaviors, were categorized as mentally slow, or emotionally impaired, and were subsequently excluded from the public school system. Strauss continued to study the medical histories of this group of individuals, and discovered that they had suffered from previous brain injuries. Strauss and Lehtinen speculated that this observed abnormal behavior coupled with reported learning disabilities may actually be a result of a brain injury.

Strauss’ work filled a void by offering an alternative path for children who had formerly been tagged as stupid, lazy, careless and/or out of control. His work on behalf of TBI individuals was unprecedented in his effort to gather similar characteristics of TBI students as a misdiagnosed group, to implement an alternative educational pathway, to set up procedures for educators to ensure some measure of academic success, and to inform academic and medical professionals of the existence of a contemporary classification of disability.

Although Strauss garnered much respect in his field, the term ‘brain injured’ was found to be confusing as it was not conclusively discovered that all TBI children claimed to have learning disabilities. As well, parents of these children were hesitant to label their child with this new term. As a result, Stevens and Birch recommended the term ‘brain injured’ be changed to ‘Strauss Syndrome’ in 1957. This term more aptly concentrated on the behavioral aspects of the condition while continuing to honor Strauss’ work in the advancement of TBI. The behavioral characteristics of TBI children included inappropriate reactions to minor provocation, increased movement disproportionate to the stimulus, distractibility, poor organization, incorrect perceptions, hyperactivity, and awkward movements.

Carlson (2005) claims that in 1966, Clements coined the term, ‘minimal brain dysfunction’ (MBD) to further classify brain injuries by severity ranging from mild, such as subtle actions, to severe, such as cerebral palsy. Clements refined the general terminology of brain injured as MBD to delineate a child of near average intelligence along with behavioral and learning issues associated by changes in the brain.

The term describing the TBI child changed yet again in 1963 by Samuel Kirk who proposed the term of ‘learning disabled’ to categorize all disabilities in learning including those who suffered from a traumatic brain injury. This term has been used since that time.

Recognizing the importance of addressing the growing needs of the learning disabled population, the Federal government enacted legislation appropriately named, Individuals with Disabilities Education Act (IDEA). This body of legislation defined a learning disability as a disorder whereby ‘one or more fundamental psychological functions manifested itself in a condition’. An important amendment to IDEA was enacted in 1990, when legislation was signed naming a category specifically for traumatic brain injury giving credibility to the growing needs

of the TBI population. This amendment also ensured that TBI students were entitled to receive special education services. In 1999, one million children were categorized under the term, “brain injury” and of this group; more than 30,000 are living with a permanent disability as a result of a brain injury (NICHCY, 1999).

Causes of TBI

According to 2007 statistics gathered by the National Brain Injury Research Treatment and Training Foundation (NBIRTT), a brain injury is sustained in the United States every 21 seconds. The highest incidence occurs among individuals between 15-24 years of age and affects approximately 1.4 million Americans. The top four causes of TBI in the United States include transportation accidents (50%), falls (28%), violence (11%), other (8%), and sports and recreation injuries (3%). It may be suggested that the reason sports and recreation TBIs are not listed higher on this list is due to the lack of reporting. Another disturbing statistic involves young children where 64% of all infant brain injuries are derived from child abuse.

NBIRTT notes that males are two times as likely as females to incur brain injuries and also notable is that if a brain injury has been sustained, a person is then three times more likely to incur another brain injury. The reason for this increased probability is due to the fact that a brain injured person has decreased capabilities in cognitive functioning. The National Head Injury Foundation claims that TBI is the number one killer and the number one disability in children and adolescents.

Despite the public reporting of statistics of the incidence of TBI, often the educational community is not as well informed as the medical community. With increased teacher awareness of the causes of TBI, they will be better equipped to identify and monitor those

students who may have sustained such an injury and teachers will become an integral partner in their recovery.

Symptoms of TBI

Rosen and Gerring (1986) believe that because educators lack information about the effects of TBI, it interrupts the efficient transfer of knowledge to their students. A challenge for educators is to identify students who may be experiencing difficulties in learning due to a brain injury.

Chapman (2002) ascertains that symptoms of a student with TBI are classified as mild, moderate, and severe, and can differ dependent upon the site of injury in the brain, and the severity of the injury. Mild injuries can manifest themselves by headaches, dizziness, blurred vision, fatigue, or ringing in the ears. A TBI victim with moderate or severe injuries may experience vomiting, constant headaches, numbness, or seizures. The capacity to think is an enormous provocation for a TBI child. Due to the brain's injury, the way the student thinks ultimately changes. Symptoms of TBI may include the inability to retrieve memories, to concentrate, to focus, to sequence events, to process slowly, to read and write, and to make appropriate judgments. It is often difficult to predict how the impact of the brain injury will affect the individual's learning progress.

Gayer (1995) suggests that many times these symptoms may be misinterpreted by teachers as symptoms of other categorized disabilities such as attention deficit disorder or emotionally impaired. Teachers must be cognizant that students may not show physical impairments but will have lingering cognitive impairments. Along with these cognitive deficits are behavioral changes which are often prevalent in the TBI student.

Lerner (2005) states that Alfred Strauss attempted to identify the behavioral and biological symptoms of brain-injured children. He surmised that the behavioral characteristics included perceptual disorders, perseveration, conceptual disorders, and behavioral disorders.

Perceptual disorders disrupt the natural process of receiving information from environmental sources and processing that information for storage and later retrieval. In the mathematical mind, a student may not be capable of copying numbers, differentiating numbers and symbols which are placed in close proximity, duplicating shapes, following algebraic steps, or recognizing patterns.

Perseveration results from difficulty in changing tasks or from the inability to exit a negative emotional experience. For example, a student may be asked to write a number pattern once, but the student will perseverate and write the number pattern continuously without end. In this same way, a student may not be able to detach themselves from a negative experience and simply revisit it without end causing emotional concerns.

Conceptual disorders deal with the inability to organize both thought and matter. This disorder can also disrupt comprehension abilities.

And finally, behavioral disorders are depicted in hyperactivity, rambling, and uninhibited and uncontrollable actions. Understandably, many children displaying this type of behavioral activity were often miscategorized as Attention Deficit Disorder (ADD) rather than suffering from symptoms of TBI.

Lerner (2005) continues by stating that Strauss continued by outlining the biological symptoms of TBI which include soft neurological symptoms and a history of neurological impairments. Soft Neurological signs are those that are subtle in appearance. Subtle signs may include an awkward gait, and difficulty in performing fine motor skills. Finally, Strauss took

great lengths to study familial medical histories. He claimed that it was imperative for the credibility of his work, to rule out any speculation of familial or inherited types of mental retardation and to exclude them from the study.

Gerganus (2007) indicates that memory problems can cause great anxiety for the TBI student. Memory allows one to retrieve stored information whether it has been built upon from experiences such as long-term memory, or the information has been used quickly, it has been filtered, used and abandoned, such as short-term memory. In a mathematical situation, memory of concepts is a building block to continued understanding of more complex tasks. Therefore, the teacher's awareness of a TBI diagnosis is critical for the student to relearn how to exercise and improve their memory.

Gerganus (2007) claims that attention is a critical component of learning in the classroom. TBI students are often categorized as ADHD due to their lack of attention during classroom instruction and the ability to stay on task. During mathematic instruction in the classroom, the TBI student suffering from inattention could exhibit such behaviors as the inability to pay attention to verbal instruction, or completing a problem, to determine usable parts of a problem, and to complete assignments.

Treatments of TBI

Professionals at the Ohio State University Medical Center (2007) state that although brain cells do not regenerate, the brain can retrain itself by detouring information to avoid the damaged part of the brain to send extra aid to the damaged brain tissue. These researchers believe that the primary goal of TBI treatment is to achieve a level of progress to enable the individual to live at home and to function in society.

Lerner (2005) claims that Alfred Strauss not only identified the theory of the brain-injured child, but was also one of the first researchers to present a course of action for educational treatment of TBI children. In 1947, along with his partner, Laura Lehtinen, they designed a learning center with the goal of reducing distractions, and of creating a calm learning environment to reduce hyperactivity. The research team redesigned the classroom with these ideals in mind such as removing desks and relocating them against the wall, covering window panes, and requesting that teachers/workers avoid wearing accessories. They also eliminated bulletin boards and other decorations in the classroom.

Gardner (2001) acknowledges that although TBI causes changes to the learning process, the brain can heal. The brain is capable of outstanding adaptations and utilizes various strategies to compensate for the inefficiencies experienced in processing. In fact, NBIRTT foundation's main goal is to discover a permanent contrivance to recover brain functions after a brain injury.

The term recovery can be misleading. Carter (1995) advises that recovery from TBI may never be attained, therefore, recovery should be looked upon as a journey and not a destination arrival. It has been suggested that the word improvement is more suitable to describe the return to a new way of thinking. Where some TBI people may experience great strides in cognitive functioning, others may not have the same experience. These improvements are often unpredictable with times of accelerated improvements followed by times of minimal change.

Williams (1994) claims that treatment in improving a TBI child's memory will be highly entrenched and not easily manipulated to improve. However, he suggests that the management of disturbances of memory gaps can be met by repetition of memory exercises, and convincing the student of the usefulness of a memory system.

Corbett (1996) suggests four basic treatment components for incorporating cognitive rehabilitation. Corbett contends that component skill training involves an identified cognitive deficit and treats it separately from environmental influences such as step instructions. Functional integration involves specifying certain skills and then blending them into the everyday environment. Compensatory techniques are used as an intermediary technique to slowly integrate the environmental influence into sequence. Prompts are helpful in this treatment as memory reminders. And finally metacognitive awareness training is used to promote independence, self-monitoring, and goal setting.

Increased attention to TBI has resulted in the opening of rehabilitation centers that now include the diagnosis and treatment of TBI. Several rehabilitation centers exist in the United States.

Established in 1994, the NeuroRehab Institute offers TBI individuals diagnosis and treatment of cognitive disorders. This center offers both an outpatient and inpatient program. Of particular interest is their inpatient program where TBI individuals exhibiting severe behavioral concerns are accepted into the program where their behavioral issues can be addressed and at the same time, enhancing their cognitive capabilities.

The NBIRTT is working collaboratively with the World Health Organization and interested scientists to look at ramifications of stem cell research as a possible cure for brain injury. Their mission is to discover ways to repair cells in the damaged brain. In addition, the NBIRTT is conducting studies to research the effectiveness of a drug named amantadinehydrochloride (AMH) which they surmise may improve the behavioral implications of brain injury, and improve some executive functions of the brain.

Neurology Channel (2007) lists alternate rehabilitation options such as minor surgery to address medical issues, psychotherapy for anxiety and depression, medication for such things as seizures, and physical therapy.

Teacher Awareness Studies of TBI

While it is obvious that medical professionals are expected to be specialists on the diagnosis of TBI, educators must also play their part by learning about relevant medical advancements in this field. Teachers need to provide identified TBI students with the appropriate learning opportunities to maximize their rehabilitation of cognitive processes. It is a well-known fact that teachers change the brains of their students on a daily basis, but are they armed with the necessary knowledge and skills to confidently teach the brain injured child?

Teacher awareness of the causes, symptoms, and treatments will clarify the mysteries of the brain and learning. In addition, it is important for teachers to be aware of medical information pertinent to the TBI child for many reasons. Teachers need to understand that the medical condition of TBI sometimes masks the expected behavior. They must also understand TBI terminology to ensure that medical reports are interpreted accurately.

Gayer (1995) claims that referrals for education services increasingly involve attention problems. While it is true that the inability to focus can have immense implications on the learning process, Gayer feels that the causes of the lack of focus could be quite varied and not always due to the disability flavor of the day, such as ADD. In the past decade, ADD has received a plethora of public and educational awareness and as a result, Gayer suggests that teachers, due to their increased education in this particular disorder, are quick to place symptoms into criteria of ADD and not consider other possible causes of the observed symptoms, such as TBI. However, for TBI students who display subtle symptoms, classroom teachers must have

the knowledge to recognize changes in a student's behavior or learning patterns and report their observations. This student may well be someone who has experienced a TBI and doesn't realize it.

The National Institute of Neurological Disorders and Strokes (NINDS) recommend a medical rehabilitation schedule that is flexible enough to be reactive to changes as progression occurs. In this same manner, NINDS appear to agree that teachers must also adjust their curriculum choice, and delivery to individualize instruction to the brain injured student to ensure optimum learning opportunities.

Teacher awareness becomes vitally important in the future success of a brain injured student. Educators must always be conscious of the possibility that learning problems may be the result of a brain injury and be careful to continually monitor the student for misdiagnosis of a learning disability. Educators, along with multi-disciplinary team members, must take great care in ensuring an accurate assessment of the brain injured student. It has been known for students to be erroneously grouped under other disability labels, such as other health impairment (OHI), or cognitively impaired (CI), despite the fact that their disability is a direct result of a brain injury. This type of inaccurate reporting and the assumption that those suffering from brain injuries are lacking intelligence, can unfortunately affect that individual's educational pursuits.

Glang (1993) believes that an educator's perceptions of their ability to teach TBI students must be evaluated. She further affirms that in-service opportunities must be provided to direct appropriate curriculum and teaching techniques. Glang feels that comprehensive, specific plans for TBI students returning to an academic environment must be enforced to meet their educational needs.

Glang (1993) maintains that educators play a crucial role in recognizing that TBI students have very different educational needs than other students and that educators have a major influence in this provision of educational needs. The researcher gains insight into teacher awareness and knowledge by asking educators to complete a quiz and a questionnaire to evaluate their perceived abilities to confidently fulfill the academic needs of TBI students.

Results revealed an average knowledge of TBI. When the same participants were asked to rank themselves with regard to preparedness to educate these students, the mean rating was “somewhat prepared”. Analysis of the data shows that knowledge and realized capability present a negative correlation. At the conclusion of the study, Glang offers the participant teacher group the opportunity to participate in a workshop about TBI.

Glang (1993) feels that educators require additional resources than simply an in-service. She suggests the addition of job coaching to ensure that this new knowledge is transferred as a new skill and to provide assistance to prepare a suitable classroom environment. As with other in-service opportunities, Glang suggests that teachers need to be given practical classroom time to apply their new skills.

Markowitz et al. (2001) claim that educators are not offered sufficient professional development about TBI. She shares the results of a survey of state education agencies (SEA) to inquire about their involvement and awareness of TBI. Markowitz summarizes that while 92% of states utilize the federally mandated category of TBI, only 20% offer pre-service programs to their educators. Of those states offering pre-service programs, many did so through seminars and in-service opportunities. Markowitz states that the existence of teacher certification in TBI was non-existent. She discovers that no state offers teacher certification in TBI and only two states offer a teacher endorsement in this disability. In the state of Oklahoma, a 32-hour program is the

minimal requirement to receive teacher endorsement in TBI. It speaks to the lack of teacher awareness of TBI and low educational priority presently existing in the United States.

Savage (1985) ascertains that educators can benefit from training about TBI and successfully apply this knowledge to teaching the TBI student. Savage claims that this additional training provides the necessary information not only academic progress, but also social and behavioral headway of students. Savage states that only 8% of special education graduate programs offer training specifically in TBI.

Cognitive Implications of Mathematical Concepts

Mathematical thinking is an integral part of the cognitive development of children. Delayed cognitive functions relating to language, memory and forming mental images of number concepts can affect the TBI learner. For example, language formation is critical for success in mathematics as it allows students to transform equations, translate mathematical tasks, and affix labels. The ability to memorize simple information like number counting and concepts will become more challenging. The formation of mental images allows a student to differentiate sets, patterns, and to explain number relationships.

Gerganus (2007) attests that teachers must be aware that language delays can be an indicator of possible mathematical delays. Gerganus (2007) recommends that in these instances, teachers can compensate for these mathematical delays through the emphasis of mastery of simple facts, finger counting, and nonverbal tasks. Gerganus claims that recognizing that children boast their own development agenda, teachers can follow simple rules for detecting mathematical developmental delays.

Glang, Singer, Cooley, & Tish (1991) contend that direct instruction is a beneficial method of teaching TBI students. They suggest that notable improvements were observed over

baseline performance following direct instruction targeted for tutoring in math including deductive reasoning, facts of addition and subtraction, and story problems. They report significant advances in new skill acquisition in all three mathematical concept areas after the treatment of direct instruction. It is their belief that if educators are more aware of the instruction methods best suited to serve the needs of TBI students, the educational pathway to success could be greatly improved.

In the rehabilitation process of TBI students, the learning path of mathematics education must be modified. Cognitive theorists suggest that TBI children should not be expected to attain mastery in mathematical concepts, rather, the focus should be in asking students to think mathematically. Students with math deficiencies, as a result of TBI, have difficulty in acquiring automacy in mathematics because the flow of information to the brain is hampered. These students have difficulty in recalling calculation facts and must exert extra effort in this recall effort, thereby leaving less energy devoted to attack other areas of mathematical learning such as problem solving. TBI students learning mathematics must be given more repetitive exercises to develop this skill.

It is not uncommon for some brain injured children to display severe math deficits with no underlying language difficulties. Duhaene et al. (2004) suggests that women suffering from Turners Syndrome showed impairments in estimation and calculation but not in tasks involving comprehension of numbers. He feels that this finding is caused by interference with the parietal region of the brain which is responsible for numerical processing. Subsequent MRIs showed that abnormalities were evident in this brain area.

Rivera et al. (2002) suggest that lower activation of the prefrontal and parietal regions of the brain explain the difficulty for Fragile X Syndrome females to perform mathematical operations.

Simon et al. (2005) claim that in studies of children with velocardiofacial syndrome, it was observed that difficulties in numerical processing were evident and determined the deficiency of the brain's posterior parietal lobe as the culprit.

Researchers seem to agree that it appears that the intraparietal sulcus is the region significant to achievement in number sense. It appears that TBI children who are identified with damage to the parietal lobe or the intraparietal sulcus are at further detriment to mathematical calculations and will require observant and specialized rehabilitation.

Duris (2001) suggests that children suffering from cognitive disabilities may lack the necessary skills in language, fine motor skills and may fatigue easily to adequately perform mathematics. These cognitive misgivings necessitate the use of specific classroom strategies to understand basic math skills. Duris contends that the use of a math curriculum called Math Touch provides a multisensory procedure to learn how to add, subtract, multiply and divide. Math Touch uses dots to represent what needs to be counted. For example, the number two would have two dots above the number with dots with circles around it to represent doubling the value. Duris feels that Touch Math can be extremely advantageous to the TBI student. Touch Math reinforces number processing and identification, and can be customized to the individual student's needs as matched to their specific cognitive condition. In this method, the student is eventually working independently on simple math computation, and therefore can achieve mastery. Duris does caution that students with limited fine motor skills may not be candidates for Touch Math unless additional modifications can be provided. TBI students have cognitive

processing concerns and Duris feels that this type of math instruction may provide additional support for their learning success.

In the 1960s, Dr. Roger Sperry suggested that each hemisphere of the brain had specialized functions. His report stated that the left hemisphere tracked speech and mathematical processes and that the right hemisphere interpreted information from imagery and predicted patterns. Hale et al. (2003) suggest that a mixed model of both left and right hemisphere processes, such as memory, and executive function allow mathematical calculation. Hale claims that this contradicts the notion that it is the sole responsibility of the right hemisphere to perform mathematics and that perhaps it is a joint effort of the left and right hemispheres. Despite this the original claim that each hemisphere appeared to have separate of functions, there seems to be research contending the functioning of both hemispheres work together permitting learning to take place.

Gruber et al. (2001) claim that although calculation is a function of the parietal lobe, they feel that more complicated mathematical processing is evident in the frontal lobe. They claim that cognitive processes of calculation involve many parts of the brain and are not centralized solely in the parietal lobe. In the TBI learner, this information is encouraging as it may indicate that it supports an overall functioning of the brain for mathematics and thus, if brain damage is centralized in the parietal lobe, perhaps number sense will not be completely affected.

Entering the right/left hemisphere debate is Kitchens (1991) who suggests that perhaps educators may not be teaching mathematical skills adequately to students by discriminating against right-brain dominant students. She feels that teachers have not addressed the cognitive potential of the right hemisphere in mathematic instruction and thus have actually discriminated against those who are dominant right-brain learners. She claims that students approach

arithmetic problems from a left or right brain, and therefore, teachers must be aware of this difference and teach to the hemispheric dominance displayed by the student.

Dr. Ronald Baumanis (2007) states that research performed in the area of mathematical recovery is not well documented. This is because, in his opinion, many brain injuries do not affect the right parietal lobe where math processing is centralized. He indicates that sometimes the frontal lobe can affect some aspects of mathematical problem solving with regard to language or organization. In his research, he finds that his patients studying for a high school diploma rarely have trouble passing the mathematics portion of the test; rather it is the language sections that give them difficulty.

Conclusion

The years ahead promise to be exciting for those interested in fulfilling a vision of improving educational practice for TBI learners on the basis of scientific research. It is becoming evident that teacher awareness of TBI in the classroom will continue to subjugate and exercise its influence on education. What needs to be addressed now is the development of a productive plan of instructional goals to address how students learn and to develop appropriate instructional methods to meet the unique needs of traumatic brain injured students. The sharing of vision between the medical community and educators is an important relationship to ensure opportunities are afforded to TBI learners returning to the classroom to continue their academic pursuits.

As shown in studies, educating academic professionals is a key component to TBI learner's success. Teachers require updated training, teacher endorsement opportunities, and development including in-services, workshops and seminars. In addition, the parent-educator-doctor relationship must be inspired to ensure a sharing of information in establishing the most

effective, individualized learning plan to service the TBI student. Teachers need to acknowledge that TBI describes an event, not a condition, that the rate and degree of recovery may only be influenced by educational interventions, that academic achievement doesn't reflect cognitive recovery or lack thereof, that resources need to be sought to facilitate the cognitive recovery of TBI and finally that TBI is a journey not an event.

Continuing research into the treatment of TBI is of utmost importance. With the incident rate on the rise and more individuals surviving severe brain trauma, Connor et al. (2001) report that funds to study the treatment of TBI receives than one cent of each Federal dollar directed on medical research. It is clear that additional research is needed to extend the investigation of instructional avenues and presentation options within the brain injured population.

If teacher awareness of TBI can be increased, and classroom instruction methods can be matched to the TBI learner, perhaps the rehabilitation of cognitive processes, including mathematical calculation, can have a profound impact on the quality of life for the brain injured population.

Chapter III: Methodology

Research Design

The research design will present a mixed model. Quantitative data will reveal previously collected data from notable educational and scientific professionals and organizations regarding statistics speaking to the causes of TBI, typical symptoms characteristic of TBI, usage of treatments available to TBI learners, and studies of previous teacher awareness studies.

Qualitative data will be collected through the distribution of a Likert Scale Survey to measure teacher awareness of TBI. The Survey will include statements on a scale of 1 to 5 (aware/not aware and agree/disagree) about the disorder, causes, symptoms, awareness of effective classroom instruction methods, possible misdiagnosis of other disorders, willingness to attend workshops, in-services, and willingness to pursue additional certifications in TBI.

Theoretical Framework

This research study will not utilize a theoretical framework as it does not serve to describe, explain, predict or control the issue of teacher awareness and TBI.

Sampling

A purposeful selection sampling will provide participants for this study. They will include currently employed classroom general and special education teachers. Volunteer participants will be selected from one public school district across all grade levels in a suburban Southeastern Michigan school. Permission will be obtained from the Principal of this high school before any research is conducted.

Variables

An extensive review of literature will be conducted to provide documentation of the causes, symptoms, and treatments of TBI and teacher willingness to modify classroom instruction to teach to the changed brain of a TBI individual. This literature review will determine the variables used in this research. A two part survey including true/false statements and Likert Scale Survey will derive the constructs of teacher awareness of TBI.

Methods of Data Collection

The process of triangulation will address the three methods of collecting qualitative data utilized for this investigation.

Previously documented data will be collected from published professional organizations.

Personal communication will be requested of Dr. Ron Baumanis of Brain Trainers, Dr. Eugene Shaw, Professor of Education at Marygrove College, Patricia Katchman, Supervisor of Special Education for Birmingham Public Schools and Frank Ventrella, Special Education Teacher. Communications will be documented in email correspondence for accuracy and liability purposes.

In addition, a two-part survey will be mailed to a minimum of 20 mathematics teachers. The survey will be directed to those individuals who have teaching experience and are presently teaching in a classroom. Questions will be driven by the research objective and will include teacher knowledge of the causes, symptoms, and treatments available to TBI individuals. The survey will include questions regarding willingness to modify classroom curriculum and instruction to address the unique needs of TBI students. Questions will be checked to eliminate leading questions and will avoid the inadvertence of threatening innuendos.

Data Analysis Procedures

Data shared by notable professionals will be summarized into numerical and categorical charts to support previously documented implications made regarding the causes, symptoms and treatments of TBI.

Data derived from the Likert Scale Survey will be interpreted separately and summarized as interval data. Each item will be analyzed individually or an accumulated score will be calculated to derive a score for the category. Each variable will investigate the level of correlation. The data collected from this survey will be separated into two categories—teacher response to TBI student and administrative support of TBI student. Numerical percentages will be calculated according to responses and charts will then condense this data for presentation.

Ethics and Human Relations

Survey and interview results garnered from this study will be kept strictly confidential and will not be shared with any other party to safeguard all participants. The questionnaire will be returned to the investigator in an addressed envelope with no identifying features to indicate its origination.

All collected data will be kept for three years from the time of the study and will not be shared without prior, written permission of the participant. At the end of three years, all data will be shredded. All participants will be assured of confidentiality and anonymity.

Any risks assigned to this study will be minimized to the extent possible by this researcher resulting in no intentional harm directed to any participant. All references to names, school district or classroom assignment will be eliminated or given fictitious labels. Participants may, at any time, choose to withdraw from any part of this research study and request that their data not be reflected in the study.

Timeline

Surveys will be formulated and delivered after receiving approval from the IRB and collected over a 2 week period. This timeline will allow questionnaires to be completed before the end of summer school, July 2008.

Correspondence from professionals will be placed after receiving IRB approval and will be conducted over a 2 week period dependent upon availability. Once surveys have been collected and the interviews have been completed, data analysis will be initiated.

Summary

This research study hopes to increase teacher awareness of the manifestation of TBI and to extend research regarding teacher awareness of the cognitive implications affecting the TBI learner. It will specifically speak to the TBI learner in a mathematical classroom setting. An in-service presentation of this research study will be presented to the school district's special education department upon approval and completion.

The brain is the hard drive of the individual. It distinguishes how we define ourselves, how we think, and how we behave. Scientists, armed with advanced medical technologies, are now beginning to uncover the mysteries of the brain and to determine how the brain learns. This new brain knowledge not only extends the medical odds of surviving a TBI, but it serves to enhance the educational probability of academic success from improved teacher awareness. Armed with the new knowledge of brain functioning, teachers will be better equipped to understand the capabilities of a brain injured student and to direct instruction and curriculum to teach to this changed brain.

Increased attention to the causes, symptoms, and treatments associated with TBI, may encourage teachers to seek professional development in the area of TBI through workshops, in-

services and educational endorsements. Increased knowledge will aid the teacher in detecting and intervening when cognitive delays are observed. This increased awareness can also serve to promote early detection of cognitive delays due to undocumented TBI, and also to prevent the misdiagnosis of TBI under the guise of multiple categorized disabilities which share the same attributes.

This study proposes to address the changed brain of the TBI learner and lend insight and increase awareness of teachers of the neurocognitive processes involved in achieving mathematical success for the TBI student returning to the classroom.

Chapter IV: Presentation of Data

Introduction

The intent of this mixed model study is to examine the level of knowledge and awareness of mathematic teachers of the manifestation of traumatic brain injury students relative to its causes, symptoms, treatments, and instruction methods.

This researcher presented a two section survey to collect data including fifteen part questionnaire (see Appendix C), and a five-degree Likert scale survey (see Appendix C). Fifteen true/false questions were presented in section one of the survey to measure participants' current knowledge of TBI as it relates to mathematics. The Likert scale, offered in section two, surveyed participants to rate their feelings of the extent to which they are willing to modify classroom instruction and curriculum and to individualize student academic plans to support TBI students in their classroom. Further, the Likert scale surveyed the degree to which teachers feel they are supported by their school district by professional development opportunities and supplementary resources to aid TBI students. The ratings were as follows: strongly disagree, disagree, undecided, agree, and strongly agree.

The data collected were graded according to documented research to measure the awareness of mathematics teachers of TBI - the disorder, causes, symptoms, and effective classroom instruction methods to teach mathematical concepts. In addition, this data measured mathematics teachers' awareness of TBI with respect to educational curriculum presentation, administrative support, and a willingness to attend workshops, in-services, and pursuit of additional certifications in TBI.

Presentation of Data

This researcher provided the three-section survey to one senior administrator and one senior mathematics department chair of one public school district in Southeastern Michigan on May 22, 2008. After receiving approval from these school district officials, this researcher distributed twenty Acknowledgement Forms, Consent Forms and surveys to perspective participants in sealed, confidential envelopes through interoffice mail. Participants returned forms to this researcher through an identical method of delivery. Sixteen forms were returned within a two week period with the remaining four forms being returned within a two- month period. The reason for this delay was a result of the end of the school year which made return more difficult.

The first section of the survey involved a questionnaire seeking true/false responses to measure mathematics teachers' awareness of TBI - the disorder, causes, symptoms, and effective classroom instruction methods to teach mathematical concepts. The data presented in Tables 1 through 15 summarizes the responses to the survey.

Table 1 was utilized to test current knowledge of mathematics teachers to the question, "The earlier in development in which a brain injury occurs, the more effect it will have on basic learning processes."

Table 1. Basic Knowledge of TBI.

Response	Response-Percent	Number
True	85%	N=17
False	15%	N=3

The preceding are the results of the data collected regarding the teachers' basic knowledge of the impact of learning processes dependent upon the stage of brain development. Conner et al (2001) suggest that brain injuries occurring early in brain development effect basic learning processes to a greater degree due to the method of foundational learning of skills early in life. 85% of respondents answered correctly with an answer of true.

Table 2 was utilized to test current knowledge of mathematics teachers to the question, 'Remediation should focus on developing learning strategies rather than helping with academic activities.'

Table 2. Basic Knowledge of TBI.

Response	Response-Percent	Number
True	70%	N=14
False	30%	N=6

The preceding are the results of the data collected regarding the teachers' basic knowledge of the focus of learning to ensure maximum academic support to the TBI student. Conner et al (2001) suggest that the TBI student requires a concentration on learning strategies with a focus on structure rather than on the receipt of academic assistance. 70% of respondents indicated a correct response of true.

Table 3 was utilized to test current knowledge of mathematics teachers to the question, 'Brain injuries often go undetected.'

Table 3. Basic Knowledge of TBI.

Response	Response-Percent	Number
True	70%	N=14

False	30%	N=6
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The preceding are the results of the data collected regarding the teachers' basic knowledge of how obvious a brain injury is to the untrained or uninformed observer. Conner et al (2001) state students with brain injuries often go unnoticed in the classroom due to the subtle nature of TBI symptoms. 70% of participants indicated a correct response of true.

Table 4 was utilized to test current knowledge of mathematics teachers to the question, 'Rudimentary number sense exists in the brain at birth.'

Table 4. Mathematics and the TBI Learner.

Response	Response-Percent	Number
True	60%	N=12
False	40%	N=8

The preceding are the results of the data collected regarding teachers' basic knowledge of the brain's mathematical processing specific to the TBI student. Cognitive theorists claim that number sense exists in the brain at birth and does not have to be artificially nurtured. 60% of respondents answered correctly with the reply of true.

Table 5 was utilized to test current knowledge of mathematics teachers to the question, 'Number sense calculation takes place in the right parietal lobe.'

Table 5. Mathematics and the TBI Learner.

Response	Response-Percent	Number
True	60%	N=12
False	40%	N=8

The preceding are the results of the data collected regarding basic knowledge of teachers to the brain's ability to process mathematics specific to the TBI learner. Gruber et al (2001) suggest that cognitive processes of calculation involve many parts of the brain and are not centralized solely in the parietal lobe as once thought. 40% of respondents indicated the correct answer of false.

Table 6 was utilized to test current knowledge of mathematics teachers to the question, 'Independent work on mathematical problems, followed by positive or negative feedback, can be beneficial to all students, including the TBI learner.'

Table 6. Mathematics and the TBI Learner

Response	Response-Percent	Number
True	95%	N=19
False	5%	N=1

The preceding are the results of the data collected regarding basic knowledge of teachers to the brain's mathematical processing specific to the TBI learner. According to behaviorist theorists, TBI learners are capable of retraining their brains through a series of positive and negative re-enforcers. 95% of teachers responded with the correct response of true.

Table 7 was utilized to test current knowledge of mathematics teachers to the question, 'Sequential presentation of mathematical concepts is essential for the TBI student.'

Table 7. Mathematics and the TBI Learner

Response	Response-Percent	Number
True	95%	N=19

False	5%	N=1
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The preceding are the results of the data collected regarding basic knowledge of teachers to the brain's mathematical capabilities specific to the TBI learner. Corbett (1996) suggests sequencing as a key cognitive communication deficit exhibited in TBI students. 95% of participants answered with the correct response of true.

Table 8 was utilized to test current knowledge of mathematics teachers to the question, 'Mathematical thinking crosses most cognitive development in children.'

Table 8. Mathematics and the TBI Learner

Response	Response-Percent	Number
True	75%	N=15
False	25%	N=5

The preceding are the results of the data collected regarding basic knowledge of teachers to the brain's mathematical capabilities specific to the TBI learner. Cognitive theorists claim mathematical thinking is an integral component of the cognitive development of children. They add that delayed cognitive functions relating to language, memory and forming mental images of number concepts can directly affect the TBI student. 75% of respondents indicated the correct response of true.

Table 9 was utilized to test current knowledge of mathematics teachers to the question, 'Language delays do not affect mathematical delays.'

Table 9. Mathematics and the TBI Learner

Response	Response-Percent	Number
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True	35%	N=7
False	65%	N=13

The preceding are the results of the data collected regarding basic knowledge of teachers to the brain's mathematical capabilities specific to the TBI learner. Gerganus (2007) suggests that teachers must be aware that language delays can be a possible indicator of mathematical delays. 65% of participants answered with the correct response of false.

Table 10 was utilized to test current knowledge of mathematics teachers to the question, 'Mastery of simple facts, finger counting, and nonverbal mathematical tasks cannot compensate for mathematics students exhibiting language delays.'

Table 10. Mathematics and the TBI Learner

Response	Response-Percent	Number
True	40%	N=8
False	60%	N=12

The preceding results of the data collected regarding basic knowledge of teachers to the brain's mathematical capabilities specific to the TBI learner. Gerganus (2007) suggests that teachers can compensate for mathematical delays through the emphasis of mastery of such things as finger counting and simple facts. 60% of respondents answered correctly with the answer of false.

Table 11 was utilized to test current knowledge of mathematics teachers to the question, 'Direct instruction will not enhance the learning of the TBI student more than other methods of instruction.'

Table 11. Mathematics and the TBI Learner

Response	Response-Percent	Number
True	25%	N=5
False	75%	N=15

The preceding results of the data collected regarding basic knowledge of teachers to the brain's mathematical capabilities specific to the TBI learner. Glang et al (1991) contend that direct instruction is a beneficial method of teaching TBI students and noted observable improvements over baseline performance in math. 75% of participants answered with the correct response of false.

Table 12 was utilized to test current knowledge of mathematic teachers to the question, "Thinking mathematically should be emphasized over the attainment of mastery in mathematical concepts."

Table 12. Mathematics and the TBI Learner

Response	Response-Percent	Number
True	60%	N=12
False	40%	N=8

The preceding results of the data collected regarding basic knowledge of teachers to the brain's mathematical capabilities specific to the TBI learner. Cognitive theorists believe that students with TBI have difficulty with acquiring automacy in mathematics because the flow of information to the brain is being hampered. The rehabilitation process of TBI students involves

the modification of this learning path of repetition in the place of thinking mathematically. 60% of participants answered with the correct response of true.

Table 13 was utilized to test current knowledge of mathematics teachers to the question, 'Repetition of mathematical concepts will not enhance the TBI learner's acquisition of it.'

Table 13. Mathematics and the TBI Learner

Response	Response-Percent	Number
True	25%	N=5
False	75%	N=15

The preceding results of the data collected regarding basic knowledge of teachers to the brain's mathematical capabilities to the TBI learner. Cognitive theorists suggest that repetition of mathematical concepts is necessary to develop the skills required for instant recall.

Table 14 was utilized to test current knowledge of mathematics teachers to the question, "TBI students can exhibit delays in estimation and calculation but not in number comprehension."

Table 14. Mathematics and the TBI Learner

Response	Response-Percent	Number
True	30%	N=6
False	60%	N=14

The preceding results of the data collected regarding basic knowledge of teachers to the brain's mathematical capabilities to the TBI learner. Duhaene et al (2004) feel this is due to an interference with the parietal region of the brain which is responsible for number processing. 30% of participants answered with the correct response of true.

Table 15 was utilized to test current knowledge of mathematics teachers to the question, ‘Boys perform better at mathematical reasoning than girls.’

Table 15. Mathematics and the TBI Learner

Response	Response-Percent	Number
True	35%	N=7
False	65%	N=13

The preceding results of the data collected regarding basic knowledge of teachers to the brain’s mathematical capabilities to the TBI learner. Although once thought that boys perform better than girls at mathematical exercises, researchers now believe that there is no evidence to support this claim. 65% of participants responded with the correct answer of false.

The second section of the survey presents a Likert scale survey to measure the degree to which mathematics teachers are willing to adapt academic curriculum delivery to serve TBI students in their classroom. It also attempts to determine the degree to which teachers feel supported by their school district to become more knowledgeable about TBI through professional offerings and supplementary resources. The scale determines level 1 to be strongly disagree, level 2 to be disagree, level 3 to be undecided, level 4 to be agree, and level 5 to be strongly agree. The data presented in Tables 16 through 27 summarizes the responses to the survey. Correct answers are presented in the color red.

Table 16 was utilized to test the degree to which mathematics teachers feel that, “A referral system exists in my building which clearly identifies students diagnosed with TBI”

Table 16. Administrative Support of TBI Students

Response	Response-Percent	Number
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Strongly Disagree	30%	N=6
Disagree	20%	N=4
Undecided	40%	N=8
Agree	5%	N=1
Strongly Agree	5%	N=1

The preceding are the results of the data collected regarding the existence of a referral system in the teacher's building which clearly indicates which students are identified as TBI. 30% of the teachers surveyed strongly disagree, 20% of the teachers surveyed disagree, 40% of the teachers surveyed were undecided, 5% of the teachers surveyed agree and 5% of the teachers surveyed strongly agree. This indicates that 50% of the teachers surveyed do not feel supported by a referral system within their school that clearly identifies TBI students and 40% of the teachers surveyed were undecided. 90% of the teachers surveyed do not feel that school administration support is evident.

Table 17 was utilized to test the degree to which mathematics teachers feel that, 'TBI is a category which my school identifies on individualized evaluation plans (IEPs) for students.

Table 17. Administrative Support of TBI Students.

Response	Response-Percent	Number
Strongly Disagree	15%	N=3
Disagree	25%	N=5
Undecided	35%	N=7
Agree	20%	N=4
Strongly Disagree	5%	N=1

The preceding are the results of the data collected surveying if teachers feel that IEPs properly identify TBI students in their classrooms. 15% of the teachers surveyed strongly disagree. 25% of the teachers surveyed disagree. 35% of the teachers surveyed were undecided. 20% of the teachers surveyed agree and 5% of the teachers surveyed strongly agree. This indicates that 40% of the teachers surveyed feel that evidence to identify TBI as a category on IEPs is inadequate. It also indicates that 75% of the teachers surveyed feel that evidence to identify TBI as a category on IEPs is not clearly stated.

Table 18 was utilized to test the degree to which mathematics teachers feel that, “I adapt my curriculum to recognize each student’s unique learning capabilities.”

Table 18. Teacher Response to TBI Students

Response	Response-Percent	Number
Strongly Disagree	0%	N=0
Disagree	10%	N=2
Undecided	35%	N=7
Agree	40%	N=8
Strongly Agree	15%	N=3

The preceding are the results of the data collected regarding the degree to which teachers feel that they modify their curriculum to teach to each student’s unique capabilities. 0% of the teachers surveyed strongly disagree, 10% of the teachers surveyed disagree, 35% of the teachers surveyed are undecided, 40% of the teachers surveyed agree, and 15% of the teachers surveyed

strongly agree. This indicates that 55% of the teachers surveyed modify their academic plans to enable all students to learn in their own unique learning style.

Table 19 was utilized to test the degree to which mathematics teachers are “flexible in adjusting expectations for TBI students.”

Table 19. Teacher Response to TBI Student

Response	Response-Percent	Number
Strongly Disagree	10%	N=2
Disagree	0%	N=0
Undecided	15%	N=3
Agree	40%	N=8
Strongly Agree	35%	N=7

The preceding data are the results of the data collected regarding the flexibility of teachers to adjust curriculum expectations for TBI students in their classroom. 10% of the teachers surveyed strongly disagree. 0% of the teachers surveyed disagree. 15% of the teachers surveyed were undecided. 40% of the teachers surveyed agree. 35% of the teachers surveyed strongly agree. This indicates that 75% of the teachers surveyed are willing to adjust expectations for TBI students in their classroom.

Table 20 was utilized to test the degree to which mathematics teachers “always review test material prior to administration.”

Table 20. Teacher Response to TBI Student

Response	Response-Percent	Number
Strongly Disagree	0%	N=0

Disagree	0%	N=0
Undecided	10%	N=2
Agree	25%	N=5
Strongly Agree	65%	N=13

The preceding are the results of the data collected regarding the practice of teachers to review material with students prior to test taking. 0% of the teachers surveyed strongly disagree or disagree. 10% of the teachers surveyed were undecided. 25% of the teachers surveyed agree. 65% of the teachers surveyed strongly agree. This indicates that 90% of teachers surveyed feel strongly that they review test material prior to administration.

Table 21 was utilized to test the degree to which mathematics teachers feel, “My school offers opportunities to learn about TBI through in-services, professional development seminars or conferences.”

Table 21. Administrative Support of TBI Students

Response	Response-Percent	Number
Strongly Disagree	60%	N=12
Disagree	30%	N=6
Undecided	10%	N=2
Agree	0%	N=0
Strongly Agree	0%	N=0

The preceding are the results of the data collected regarding opportunities for teachers to attend venues to learn more about TBI. 60% of the teachers surveyed strongly disagree. 30% of

the teachers surveyed disagree. 10% of the teachers surveyed were undecided. 0% of the teachers surveyed agree or strongly agree. This indicates that 90% of the teachers surveyed feel that opportunities are not made available to allow further explore the manifestation of TBI and to learn how best to deal with students in their classrooms who may be suffering from TBI.

Table 22 was utilized to test the degree to which mathematics teachers feel, “My classroom conveys a sense of order both physically and visually.”

Table 22. Teacher Response to the TBI Student

Response	Response-Percent	Number
Strongly Disagree	0%	N=0
Disagree	0%	N=0
Undecided	10%	N=2
Agree	50%	N=10
Strongly Agree	40%	N=8

The preceding are the results of the data collected regarding the classroom environment to ensure students, including TBI students, receive instruction in an orderly classroom. 0% of the teachers surveyed strongly disagree or disagree. 10% of the teachers surveyed were undecided. 50% of the teachers surveyed agree. 40% of the teachers surveyed strongly agree. This indicates that 90% of the teachers surveyed feel that their classrooms present a physically and visually orderly classroom.

Table 23 was utilized to test the degree to which mathematics teachers feel, “I am willing to adjust my teaching style to accommodate TBI students.”

Table 23. Teacher Response to TBI Student

Response	Response-Percent	Number
Strongly Disagree	0%	N=0
Disagree	0%	N=0
Undecided	20%	N=4
Agree	25%	N=5
Strongly Agree	55%	N=11

The preceding are the results of the data collected regarding the willingness of teachers to adjust their teaching style to accommodate TBI students in their classroom. 0% of the teachers surveyed strongly disagree or disagree. 20% of the teachers surveyed were undecided. 25% of the teachers surveyed agree. 55% of the teachers surveyed strongly agree. This indicates that 80% of the teachers surveyed are willing to adjust their teaching style to accommodate the TBI student.

Table 24 was utilized to test the degree to which mathematics teachers feel, “District resources are available to me to implement compensatory strategies to aid in the success of a student with TBI deficiencies.”

Table 24. Administrative Support of TBI Students

Response	Response-Percent	Number
Strongly Disagree	25%	N=5
Disagree	25%	N=5
Undecided	40%	N=8
Agree	5%	N=1
Strongly Agree	5%	N=1

The preceding are the results of the data collected regarding how teachers feel about support offered by administration to offer district resources to allow teachers to supplement strategies to aid in the success of the TBI student. 25% of the teachers surveyed strongly disagree or disagree. 40% of the teachers surveyed were undecided. 5% of the teachers surveyed agree. 5% of the teachers surveyed strongly agree. This indicates that 90% of the teachers surveyed feel that district resources are not available to aid in offering supplementary aids to ensure the success of the TBI student.

Table 25 was utilized to test the degree to which mathematics teachers feel, “I identify and remove elements of the classroom environment which can restrict a student’s learning or pose barriers.”

Table 25. Teacher Response to TBI student

Response	Response-Percent	Number
Strongly Disagree	0%	N=0
Disagree	0%	N=0
Undecided	24%	N=6
Agree	45%	N=9
Strongly Agree	25%	N=5

The preceding are the results of the data collected regarding the willingness of teachers to identify and remove classroom elements which can restrict a student’s learning or pose barriers. 0% of the teachers surveyed strongly disagree or disagree. 24% of the teachers surveyed were undecided. 45% of the teachers surveyed agree. 25% of the teachers surveyed strongly agree.

This indicates that 70% of the teachers surveyed feel they remove barriers which could impede learning.

Table 26 was utilized to test the degree to which mathematics teachers feel, “I consider the student’s location in relation to the teacher’s usual teaching position.”

Table 26. Teacher Response to TBI student

Response	Response-Percent	Number
Strongly Disagree	0%	N=0
Disagree	0%	N=0
Undecided	0%	N=0
Agree	45%	N=9
Strongly Agree	55%	N=11

The preceding are the results of the data collected regarding whether teachers consider the student’s location in relation to the teacher’s usual teaching position. 0% of the teachers surveyed strongly disagree, disagree or were undecided. 45% of the teachers surveyed agree. 55% of the teachers surveyed strongly agree. This indicates that teachers feel that they consider a student’s position in relation to where they usually position themselves to teach.

Table 27 was utilized to test the degree to which mathematics teachers feel, “I am interested in learning more about the effects of the TBI learner.”

Table 27. Teacher Response to TBI Student

Response	Response-Percent	Number
Strongly Disagree	0%	N=0
Disagree	0%	N=0

Undecided	50%	N=10
Agree	30%	N=6
Strongly Agree	20%	N=4

The preceding are the results of the data collected regarding the level of interest of teachers to learn more about the effects of the TBI learner. 0% of the teachers surveyed strongly disagree or disagree. 50% of the teachers surveyed were undecided. 30% of the teachers surveyed agree. 20% of the teachers surveyed strongly agree. This indicates that 100% of the teachers surveyed indicated an adequate to strong interest in learning more about the TBI student.

The data collected from section one of this survey received an overall raw score of 204 out of a possible 300 points. This calculates to a percentage score of 68. Outlying data included in this section included a question concerning number sense calculation taking place in the right parietal lobe where teachers recorded a 40% correct response percentage. Additionally, outlying data included a question concerning TBI students exhibiting delays in estimation and calculation but not in number comprehension where teachers recorded a 30% correct response percentage. This indicates to this researcher that teachers convey an adequate overall basic knowledge of brain injuries and its basic effects on the TBI student in a learning environment.

The data collected from section two of this survey indicated that on questions of teacher response to TBI students, teachers surveyed agree or strongly agree that they are willingness to accommodate TBI students through a variety of methods. On issues of administrative support of the TBI student, teachers surveyed strongly disagree or disagree that administrative support of TBI students in their classroom is present. This appears to indicate to this researcher that teachers

surveyed indicated a strong interest in learning more about the TBI learner. Teachers surveyed indicated a feeling of lack of district administrative support to identify TBI students, support to attend conferences, seminars and in-services, and support to be provided with resources to implement strategies to aid the TBI learner.

Conclusion

This two part questionnaire and Likert scale survey explored the extent to which mathematics teachers are aware of the manifestation, causes, symptoms, and treatments of TBI as it relates to educating TBI students in a mathematics classroom setting. Additionally, it served to extend research regarding the extent to which mathematics teachers are willing to improve their awareness and methods of teaching, and to attend professional development opportunities.

The results of this data conclude to this researcher that teachers convey an adequate basic knowledge of brain injuries and its basic effects on the TBI student. It also indicates a willingness by teachers to modify instructional methods, to make curriculum adjustments, to thoughtfully position TBI students in the classroom and to offer a classroom environment conducive to the TBI learner including additional resources when necessary. Mathematics teachers surveyed indicated a strong interest in learning more about the TBI learner. Mathematics teachers surveyed indicated a lack of district administrative support to identify TBI students, support to attend conferences, seminars and in-services, and provision of resources to implement strategies to aid the TBI learner.

Chapter V: Summary, Conclusion, and Recommendation

Introduction

This researcher has investigated the knowledge and awareness of mathematics teachers of the manifestation of traumatic brain injury students relative to its causes, symptoms, treatments and instruction methods. These attributes were examined from the teacher's perspective in the form of a two part survey including a questionnaire, and a Likert scale survey. The results of this investigation suggest that mathematic teachers reveal an adequate basic knowledge about brain injuries as it relates to learning mathematics and a willingness to become more knowledgeable about instructional methods to ensure the success of TBI students in classrooms. Further, the results of this research also suggest a lack of support by administrators in the school district to provide adequate resources and professional opportunities to allow mathematic teachers to further their understanding of how best to instruct TBI students. This researcher conducted the two part survey which will be summarized. Moreover, an overview of the results and recommendations will be presented by this researcher. These recommendations will give direction to future research required to gain additional insight into the significance of the awareness of mathematic teachers in providing effective academic instruction to TBI students.

Summary

This researcher explored the awareness of mathematics teachers of the manifestation, causes, symptoms, and treatments of TBI as it relates to educating TBI students. Additionally, this researcher investigated the extent to which mathematics teachers are willing to improve their awareness and methods of teaching TBI students, or to attend professional forums to increase their knowledge. An extensive review of literature was completed including textbooks, journal articles, targeted educational magazines, ERIC databases, and doctoral level dissertations. Email

correspondence was initiated by this researcher with two professionals in the area of brain injuries. A two part survey including fifteen true and false questions, and twelve Likert scale survey statements was administered to twenty mathematic teachers from a Southeastern Michigan public school district across all grades, kindergarten through twelfth grade. The survey was conducted to determine the extent to which mathematic teachers were aware of TBI, its effect on student learning, and their willingness to learn more about TBI. In addition, the survey was designed to contribute to the knowledge base for improving strategies for instruction to enhance the learning environment for TBI students.

Upon gathering the survey results, survey responses and levels were ascertained. Each answer was deemed correct or incorrect, and levels of agreement were determined. The responses were calculated by compiling correct versus incorrect answers based on previously documented research. Levels of agreement were determined according to a feeling of strength or weakness to the statement. Upon summary, the percentage of correct responses and degree was determined. The knowledge base and willingness to respond individually to the TBI student was recorded at level 3-5 which is deemed adequate. A feeling of administrative support was recorded at level 1-2 which is deemed weak.

Conclusions

The data from the two part survey revealed that 68% of mathematic teachers display an adequate basic knowledge of the brain and how the brain of the TBI student manipulates mathematical concepts. Therefore, the results suggest that mathematic teachers are somewhat aware of the manifestation, causes, symptoms, and treatments of TBI. These results address the first research question: how aware of mathematic teachers to the manifestation, causes,

symptoms and treatments of TBI as it relates to educating TBI students in a mathematics classroom setting.

Based on the results of this survey and the review of literature regarding TBI students learning in a mathematic classroom, teacher knowledge of the manifestation of brain injuries and attention to the unique learning style best suited for maximum learning has significant implications for the TBI student. Furthermore, the literature review and professional correspondence suggests that TBI students possess unique learning capabilities following TBI and require strategies and instructional methods which address their changed brain. Teachers who do not recognize TBI students in their classroom will not adequately offer the appropriate environment for maximum learning capabilities.

The second research question asked the extent to which mathematic teachers are willing to improve their awareness and methods of teaching, and to attend professional development opportunities to discover alternative practices to address the challenges of the TBI student.

Based on the results of this survey, the survey indicated a willingness of mathematics teachers to pursue educational offerings to improve their awareness and to address the needs of TBI students in their classroom. Additionally, the survey indicated a feeling of lack of support by school administration to support efforts through professional offerings or supplementary resources to aid them in their delivery of instruction to TBI students in their classroom.

Recommendations

It is this researcher's recommendation that further research be conducted regarding the unique challenges of TBI students in the classroom and the encouragement and support offered to teachers who face the daunting task of retraining the brain of a TBI student upon their return to the classroom. Research is required to offer concrete methods of identifying TBI students in

school districts and in training teachers to recognize the characteristics of the TBI learner. This may provide further insight to the role of the teacher in ensuring educational success to the TBI student.

Research has revealed an increase in the number of students re-entering classrooms after suffering a TBI. Additional research and awareness is required to permit administrators, teachers, and parents to work cohesively to implement educational plans to address the unique learning challenges of the TBI learner.

This research concludes that while medical professionals are extending the odds of surviving a TBI, educational professionals must keep step to provide the necessary educational environment to ensure academic success for the TBI student. Increased attention to the causes, symptoms, and treatments associated with TBI, may encourage teachers to seek professional development in the area of TBI through workshops, in-services and educational endorsements. Increased knowledge will aid the teacher in detecting and intervening when cognitive delays are observed. This increased awareness can also serve to promote early detection of cognitive delays due to undocumented TBI, and also to prevent the misdiagnosis of TBI under the guise of multiple categorized disabilities which share the same attributes.

This research humbly concludes that teachers show adequate awareness of the changed brain of the TBI learner and a strong will to modify instruction and to provide individualized attention of the neurocognitive processes involved in achieving mathematical success for the TBI student returning to the classroom. It also concludes that teachers seek support from their school district to advance their professional development in the area of addressing the unique challenges of the TBI student. It is this researchers hope that educators and administrators will take into

consideration that attention to the TBI student in the classroom can greatly improve academic success.

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Appendixes

Appendix A

Informed Consent Form

Dear Participant,

I am conducting a study entitled, ‘The Changed Brain: Teacher Awareness of Traumatic Brain Injury and Classroom Instruction Methods to Enhance Cognitive Processing in Mathematics’. This study will examine the level of knowledge and awareness of mathematics teachers of the manifestation of TBI relative to its causes, symptoms, treatments, and instruction methods. This study will investigate alternative mathematical instructional practices to address the challenges of the TBI survivor.

My research is initiated as a graduation requirement for a Master’s Degree at Marygrove College in Detroit, Michigan. Participation in this study is completely voluntary and you may withdraw from the study at any time without consequence to yourself or professional standing. Each participant is asked to fill out and return a signed consent form to participate form and a survey consisting of 47 statements. An enclosed envelope will expedite the return of this survey to the investigator. It is asked that if you intend to participate, that you fill out and return this survey within two weeks.

All information collected will remain confidential and anonymous except as may be required by federal, state, or local law. Additionally, it will be retained on file for up to three years.

I appreciate your consideration of this request to participate. If you have any questions or concerns, I may be contacted at (248) 593-0877 or rjodc@comcast.net. You may also direct your concerns to Human Subjects Review Committee, Dr. Rivard, HSRC Chairperson, Marygrove College, (jrivard@marygrove.edu).

Sincerely,

Judith M. Stahl
Student Investigator (SI)
Graduate Candidate
Marygrove College

Appendix B

ACKNOWLEDGEMENT AND CONSENT

I, _____, hereby state that:
(Print Full Legal Name)

1. I have read all information provided on the consent form as it related to the research study entitled, “The Changed Brain: Teacher Awareness of Traumatic Brain Injury and Classroom Instruction Methods to Enhance Cognitive Processing in Mathematics” conducted by Judith Stahl, Graduate Candidate of Marygrove College, Detroit, Michigan.
2. I have been given the opportunity to make inquiries I may have and have received responses that meet my satisfaction.
3. I have been given a cover letter explaining the research objective and instructions, an “Acknowledgement and Consent” form and the subsequent survey to complete.
4. By signing this “Acknowledgement and Consent” form, I consent to being a participant in the aforementioned study.
5. I am 18 years of age or older.

Print Participant's Full Legal Name

Date

Signature of Participant

Date

As the investigator in the study, I hereby state to the best of my knowledge and belief, all statements made in the documents listed are true. Any participants involved in this study may withdraw or discontinue participation at any time without penalty.

Print Full Name of Investigator

Date

Signature of Investigator

Date

Appendix C

SURVEY

Survey–Page 1 of 2

Investigator: Judith Stahl

Consider each statement and then decide whether it is generally true (circle T) or generally false (circle F).

1. T F The earlier in development in which a brain injury occurs, the more effect it will have on basic learning processes.
2. T F Remediation should focus on developing learning strategies rather than helping with academic activities.
3. T F Brain injuries often go undetected.
4. T F Rudimentary number sense exists in the brain at birth.
5. T F Number sense calculation takes place in the right parietal lobe.
6. T F Independent work on mathematical problems, followed by positive or negative feedback, can be beneficial to all students, including the TBI learner.
7. T F Sequential presentation of mathematical concepts is essential for the TBI student.
8. T F Mathematical thinking crosses most cognitive development in children.
9. T F Language delays do not affect mathematical delays.
10. T F Mastery of simple facts, finger counting, and nonverbal mathematical tasks cannot compensate for mathematics students exhibiting language delays.
11. T F Direct instruction will not enhance the learning of a TBI student more than other methods of instruction.
12. T F Thinking mathematically should be emphasized over the attainment of mastery in mathematical concepts.
13. T F Repetition of mathematical concepts will not enhance the TBI learner's acquisition of it.

14. T F TBI students can exhibit delays in estimation and calculation but not in number comprehension.
15. T F Boys perform better at mathematical reasoning than girls.

[Survey: Page 2 of 2](#)Investigator: Judith Stahl

On a scale of 1 (lowest) to 5 (highest), circle the number that indicates the degree to which you and/or your school district perform the following.

1. A referral system exists in my building which clearly identifies students diagnosed with TBI. 1-2345
2. TBI is a category which my school identifies on individualized evaluation plans (IEPs) for students. 1-2345
3. I adapt my curriculum to recognize each student's unique learning capabilities. 1-2345
4. I am flexible in adjusting expectations for TBI students. 1-2345
5. I always review test material prior to administration. 1-2345
6. My school offers opportunities to learn about TBI through in-services, professional development seminars or conferences. 1-2345
7. My classroom conveys a sense of order both physically and visually. 1-2345
8. I am willing to adjust my teaching style to accommodate TBI students. 1-2345
9. District resources are available to me to implement compensatory strategies to aid in the success of a student with TBI deficiencies. 1-2345
10. I identify and remove elements of the classroom environment which can restrict a student's learning or poses barriers. 1-2345
11. I consider the student's location in relation to the teacher's usual teaching position. 1-2345
12. I am interested in learning more about the effects of the TBI learner. 1-2345

Appendix D

FINAL SUMMARY

Title of Research Project: The Changed Brain: Teacher Awareness of Traumatic Brain Injury And Classroom Instruction Methods to Enhance Cognitive Processing in Mathematics

Primary Investigator: Judith M. Stahl

Date Completed: August 2008

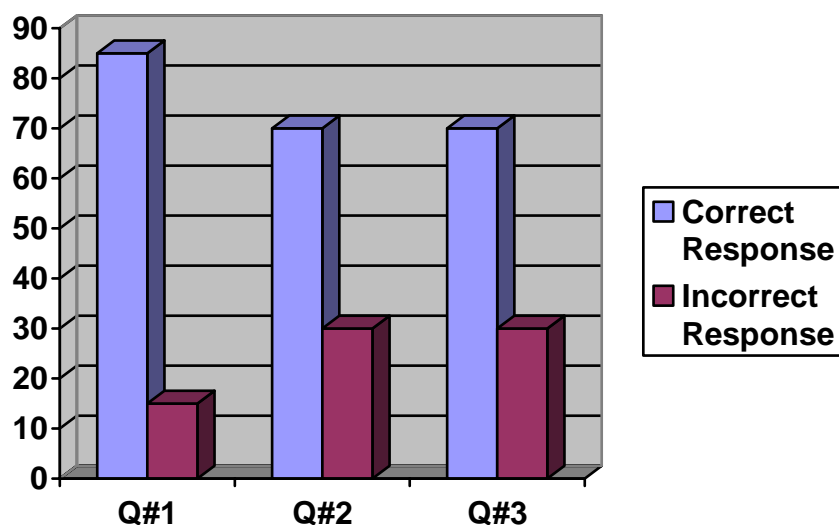
Send this form to:

Dr. James Rivard, Chair
Institutional Review Board
Liberal Arts, Library Lecture hall 207

Appendix E

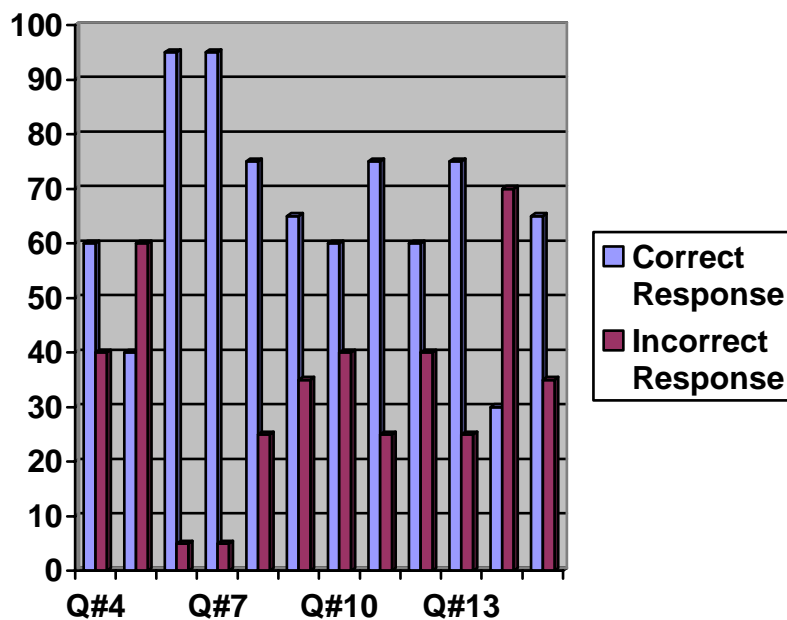
Participant Basic Knowledge of TBI

(aligned with Questionnaire #1-3 of Survey Part 1)



Participant Knowledge of Mathematics and the TBI Learner

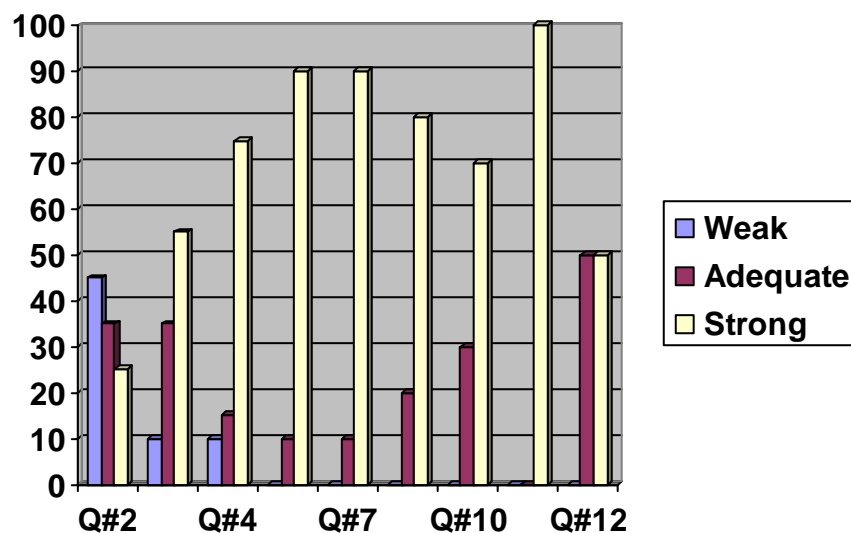
(aligned with Questions #4-15 of Survey Part 1)



Appendix F

Level of Agreement: Teacher Response of TBI Students

(aligned with Questions #2-5, 7, 8,10-12 of Survey Part 2)



Level of Agreement: Administrative Support of TBI Student

(aligned with Questions 1, 6, 9 of Survey Part 2)

